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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/817,696	03/23/2001	Howard R. Test	TI-30589	9347

7590 10/30/2003

TEXAS INSTRUMENTS INCORPORATED
P. O. BOX 655474
M/S 3999
DALLAS, TX 75265

EXAMINER	
RICHARDS, N DREW	
ART UNIT	**PAPER NUMBER**
2815	

DATE MAILED: 10/30/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/817,696	TEST ET AL.	
	Examiner	Art Unit	
	N. Drew Richards	2815	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *29 September 2003* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *7-26* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *7-16,18-22 and 24-26* is/are rejected.

7)☒ Claim(s) *17 and 23* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *23 March 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 7, 8, 11-13, 15, 16, 18, 19, 22, 24 and 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ulrich et al. ("Thermosonic Gold Wirebonding to Electrolessly-Metallized Copper Bondpads over Benzocyclobutane," 1999 International Conference on High Density Packaging and MCM's, Pp. 260-265).

Ulrich et al. teach a method of forming metallurgical connections between metal wires and bond pads having copper metallization. Ulrich et al. teach the steps of:

depositing seed metal to activate the surface of the copper metallization of the bond pads (see paragraph 5 of "Preparation of Test Structures" section);

plating a layer of barrier metal that resist copper diffusion, by electroless deposition (Ni deposited, see paragraph 5 of "Preparation of Test Structures" section);

plating a layer of a bondable metal, by electroless deposition (Au deposited, see paragraph 5 of "Preparation of Test Structures" section);

and bonding one of the metal wires onto the outermost metal (wirebonding of gold to Cu bond pads, see abstract).

With regard to the thickness of the barrier metal reducing diffusion of copper by 80% compared to the diffusion in the absence of the layer, Ulrich et al. teach using Ni

as the barrier metal and forming it to a sufficient thickness to obtain the claimed diffusion reduction.

With regard to the thickness of the bondable metal reducing diffusion of the barrier metal by 80% compared to the diffusion in the absence of the layer, Ulrich et al. teach using Au as the bondable metal and forming it to a sufficient thickness to obtain the claimed diffusion reduction.

Ulrich et al. does not explicitly state that the metallurgical connections between metal wires and bond pads are positioned on integrated circuits having copper interconnecting metallization. In paragraph 1 of the "Introduction" section, Ulrich et al. discuss the IC industry moving towards Cu-over-low-k chip architecture that may include polymers as the dielectric layers. Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention to use the bond pad metallization as claimed on integrated circuits. The motivation for using the bond pad metallization taught is that it allows wirebonding to bondpads which are located over thick polymer dielectric layers.

With regard to claim 8, Ulrich et al. teach the wire bonding step comprising ball bonding or wedge bonding.

With regard to claim 11, the step of activating is taught as immersing the bond pads in a catalytic chloride solution (see paragraph 5 of "Preparation of Test Structures" section).

With regard to claim 12, the metal chloride is palladium chloride.

With regard to claim 13, the electroless plating of the bondable metal is immersion plating (the substrate is placed in the solution for Au deposition, thus immersed, seeparagraph 6 of "Preparation of Test Structures" section).

With regard to claim 15, the limitation of electrically probing leaving no probe marks is not limiting to the process of forming the device. This step does not change the device structure in any way during the process. Further, the device of Ulrich et al. is capable of performing the probing step without leaving any marks as the outermost bondable layer of Ulrich et al. is the same as in the present invention and thus would have the same hardness to resist probe marks.

With regard to claim 16, Ulrich et al. teach a method of forming metallurgical connections between metal wires and bond pads having copper metallization. Ulrich et al. teach the steps of:

depositing seed metal to activate the surface of the copper metallization of the bond pads (see paragraph 5 of "Preparation of Test Structures" section);

plating on the seed layer a layer of barrier metal that resist copper diffusion, by electroless deposition, the barrier metal having a thickness of at least about 0.5 micrometers selected from the group consisting of nickel, cobalt, chromium, molybdenum, titanium, tungsten, and alloys thereof (Ni deposited, see paragraph 5 of "Preparation of Test Structures" section);

plating on the barrier layer a layer of a bondable metal, by electroless deposition, the bondable layer having a thickness of at least about 0.4 micrometers selected from

the group consisting of gold, palladium, platinum, and silver (Au deposited, see paragraph 5 of "Preparation of Test Structures" section);

and bonding one of the metal wires onto the outermost metal (wirebonding of gold to Cu bond pads, see abstract).

Ulrich et al. does not explicitly state that the metallurgical connections between metal wires and bond pads are positioned on integrated circuits having copper interconnecting metallization. In paragraph 1 of the "Introduction" section, Ulrich et al. discuss the IC industry moving towards Cu-over-low-k chip architecture that may include polymers as the dielectric layers. Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention to use the bond pad metallization as claimed on integrated circuits. The motivation for using the bond pad metallization taught is that it allows wirebonding to bondpads which are located over thick polymer dielectric layers.

With regard to claim 18, the barrier layer has a thickness in the range of about 0.5 to about 1.5 micrometers.

With regard to claim 19, the bondable layer has a thickness in the range of about 0.4 to about 1.5 micrometers.

With regard to claim 22, Ulrich et al. teach a method of forming metallurgical connections between metal wires and bond pads having copper metallization. Ulrich et al. teach the steps of:

depositing palladium seed metal to activate the surface of the copper metallization of the bond pads (see paragraph 5 of "Preparation of Test Structures" section);

plating on the seed layer a layer of nickel, by electroless deposition, the layer of nickel having a thickness of at least about 0.5 micrometers; (Ni deposited, see paragraph 5 of "Preparation of Test Structures" section);

plating on the layer of nickel a layer of gold, by electroless deposition, the bondable layer having a thickness of at least about 0.4 micrometers (Au deposited, see paragraph 5 of "Preparation of Test Structures" section);

and bonding one of the metal wires onto the layer of gold (wirebonding of gold to Cu bond pads, see abstract).

Ulrich et al. does not explicitly state that the metallurgical connections between metal wires and bond pads are positioned on integrated circuits having copper interconnecting metallization. In paragraph 1 of the "Introduction" section, Ulrich et al. discuss the IC industry moving towards Cu-over-low-k chip architecture that may include polymers as the dielectric layers. Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention to use the bond pad metallization as claimed on integrated circuits. The motivation for using the bond pad metallization taught is that it allows wirebonding to bondpads which are located over thick polymer dielectric layers.

With regard to claim 24, the nickel layer has a thickness in the range of about 0.5 to about 1.5 micrometers.

With regard to claim 25, the gold layer has a thickness in the range of about 0.4 to about 1.5 micrometers.

3. Claims 9, 10, 20, 21 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ulrich et al. as applied to claims 7, 8, 11-13, 15, 16, 18, 19, 22, 24 and 25 above, and further in view of Ahmad et al. (U.S. Patent No. 6,436,412).

With regard to claims 9, 20 and 26, Ulrich et al. do not teach depositing a protective overcoat over the surface of the integrated circuit including the surface having copper and metallization opening selected areas of the overcoat exposing the surface of the copper metallization. Ahmad et al. teach a method of forming copper metallization with a bond pad. Ahmad et al. teach in figure 5E depositing a protective overcoat 50 and opening selected areas of the overcoat exposing the surface of the copper metallization.

Ulrich et al. and Ahmad et al. are combinable because they are from the same field of endeavor. At the time of the invention it would have been obvious to a person of ordinary skill in the art to form a protective overcoat and etch portions away to expose the copper. The motivation for doing so is provide a passivation layer over the substrate and to insulate the copper and bonded wire from adjacent conductors. Therefore, it would have been obvious to combine Ulrich et al. with Ahmad et al. to obtain the invention of claims 9, 20 and 26.

With regard to claims 10 and 21, Ulrich et al. teach cleaning before activating the copper surface. In combination with Ahmad et al., the cleaning step would be

performed after the etching step to remove contaminants and cupric oxide. Ulrich et al. teach cleaning by immersing the exposed copper in a solution of sulfuric acid.

4. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ulrich et al. as applied to claims 7, 8, 11-13, 15, 16, 18, 19, 22, 24 and 25 above, and further in view of Gaudiello ("Autocatalytic Gold Plating Process for Electronic Packaging Applications," IEEE, Electronic Components and Technology Conference, 1995, Pp. 534-537).

With regard to claim 14, Ulrich et al. does not teach immersion plating followed by autocatalytic plating. Gaudiello teaches an autocatalytic electroless gold process for electronic packaging applications that is disclosed as a good follow on to the conventional electroless nickel/immersion gold surface finishing systems. Gaudiello thus teach immersion plating gold followed by autocatalytic plating.

Ulrich et al and Gaudiello are combinable because they are from the same field of endeavor. At the time of the invention it would have been obvious to a person of ordinary skill in the art to form the gold layer by immersion plating followed by autocatalytic plating. The motivation for doing so is to provide a high purity, nonporous soft gold layer of any thickness. Therefore, it would have been obvious to combine Ulrich et al. with Gaudiello to obtain the invention of claim 14.

Allowable Subject Matter

5. Claims 17 and 23 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Response to Arguments

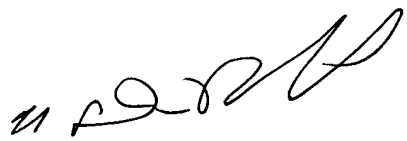
6. Applicant's arguments with respect to claims 7-26 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to N. Drew Richards whose telephone number is (703) 306-5946. The examiner can normally be reached on M-F 8:00-5:30; Every other Friday off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on (703) 308-2772. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.



NDR